

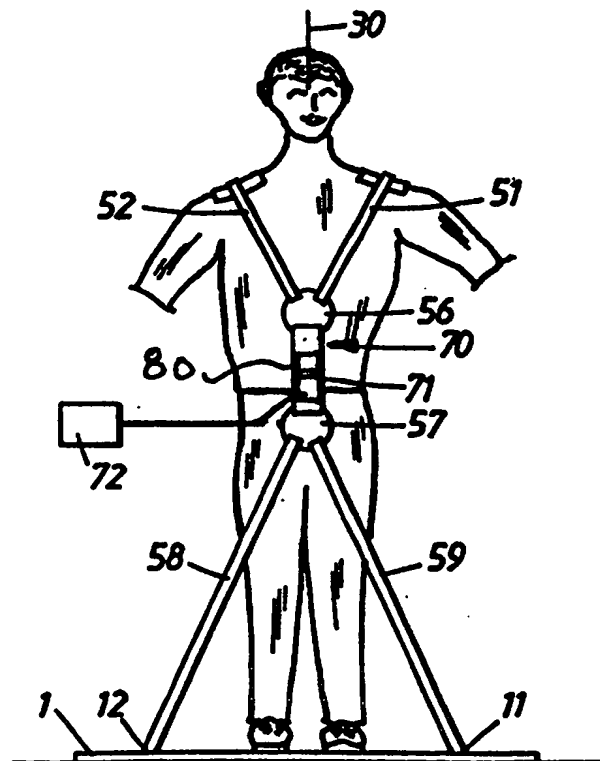


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup>:</b> <b>A63B 23/04, 23/02</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 98/23335</b> <b>(43) International Publication Date:</b> 4 June 1998 (04.06.98)
<b>(21) International Application Number:</b> PCT/SE97/01948 <b>(22) International Filing Date:</b> 20 November 1997 (20.11.97) <b>(30) Priority Data:</b> 9604398-9                      29 November 1996 (29.11.96)      SE 9702433-5                      25 June 1997 (25.06.97)                      SE <b>(71)(72) Applicant and Inventor:</b> SAMUELSSON, Rolf [SE/SE]; Rymdvägen 13, S-175 60 Järfälla (SE). <b>(74) Agents:</b> SUNDSTRÖM, Per et al.; Stenhagen Patentbyrå AB, P.O. Box 4630, S-116 91 Stockholm (SE).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>

**(54) Title:** DEVICE FOR ISOMETRIC/DYNAMIC EXERCISE/TRAINING/TESTING**(57) Abstract**

An apparatus for isometric/dynamic exercising apparatus which includes a separate bottom plate (1), wherein a flexible harness has both ends fastened to separate points on a bottom plate (1) and extends over the shoulders (22) of a user. The harness includes means for adjusting its length, so that a user wearing the harness on his shoulders and having his feet in contact with the plate is unable to stand upright or lie completely flat, so that his legs and back muscles can be stretched while exerting a maximum stretching force. A load measuring device (70) is included in the harness. The exercise is performed by the user stretching his legs and back simultaneously, therewith applying load to the leg tensors and back tensors of the user. The work carried out during the straightening cycle performed by the user can be evaluated and the power and the total work can be determined by selection of cycle frequency and by measuring the total work time. If the harness is non-stretchable, isometric training exercises can be carried out. If the apparatus is resilient or includes a spring device, dynamic training/loading can be carried out.



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**DEVICE FOR ISOMETRIC/DYNAMIC EXERCISE/TRAINING/TESTING**

5 The present invention relates to an isometric/dynamic exercising apparatus of the kind defined in the preamble of Claim 1.

10 The inventive exercising apparatus is of the general kind disclosed in US-A 882,181. The invention is thus based on an isometric/dynamic exercising apparatus of the kind that includes a harness that has two straps each of which extends over a respective shoulder of the user, wherein the harness is connected to a supportive surface against which the user places his/her feet, by means of a connecting device coupled  
15 to the harness. Connected to the apparatus is a device for measuring the power exerted by the user in moving the harness away from the supportive surface, and wherein the apparatus also includes means for adjusting the distance between the supportive surface and the part of the harness acting on the  
20 wearer's shoulders.

Both the leg tensors and the back tensors are involved when the user straightens himself/herself.

25 I have now found that an exercising apparatus of this kind is well suited for heavy isometric/dynamic muscle exercises, both in respect of healthy and sick individuals.

30 The earlier known apparatus suffers a number of drawbacks which limit the usefulness of the apparatus and its user comfort.

35 Consequently, an object of the present invention is to provide an apparatus of the aforesaid kind that has been further developed so as to avoid or reduce these drawbacks.

This object is achieved with an apparatus according to the following Claim 1:

Further embodiments of the inventive apparatus are defined in the following dependent Claims.

The inventive exercising apparatus is thus portable and can be used by patients who are confined to their beds or are bed-ridden and in need of muscle exercising and of exercising the heart and circulatory system, and to counteract the occurrence of deep venous thrombosis. As a result of the design of the foot plate and the locations of the points at which the harness is connected to the plate, the user is afforded a stable working attitude when subjecting the apparatus to load.

In one embodiment of the invention, the apparatus is essentially non-stretchable and serves for isometric exercising purposes or for subjecting the user to load, wherein the spring device is set to enable the back muscles and leg muscles to be stretched to a maximum without yielding.

In accordance with another embodiment of the invention, the apparatus has connected thereto elastically flexible spring devices which enable the apparatus to be used in the performance of dynamic exercises, even by persons that are confined to their beds or are bedridden. The load can be controlled by evaluating the maximum force or power exerted by the user on the apparatus. The user can then exert a force which suitably constitutes a chosen proportion of the maximum force over a chosen time period. The inventive apparatus may include a measuring device that is coupled in the force flow path of the apparatus for measuring power and/or work exerted by the user between the shoulders and feet.

When using the inventive apparatus, the systolic and diastolic blood pressure and the heart rate of the user will increase, both with isometric and dynamic muscle exercises. The so-called double product, which is the systolic blood pressure multiplied by the heart rate and which is abbreviated to RPP (Rate Pressure Product), constitutes a measurement of the oxygen consumption of the heart, i.e. the load to which the heart is subjected. Any load on the muscles will thus result in a load on the heart and on the circulatory system.

In this respect, the dynamic load can be used to

- investigate the heart and the circulation and also the leg and back tensors of healthy and sick individuals, for instance patients who are confined to their beds or are bed-ridden;
- investigate the function of the heart, for instance with simultaneous echocardiography registering or isotope registering techniques during an ongoing isometric or dynamic load, an example of which is investigating patients with exercise-induced myocardial ischemia (impaired blood flow to the working heart muscle under load);
- investigate the systolic and diastolic blood pressure reaction by measuring blood pressure in conjunction with dynamic or isometric exercise of the muscles;
- evaluate and monitor patients with high blood pressure, where one example is evaluating the result of treatment after introducing medical blood pressure treatment; and to
- exercise regularly with the inventive isometric/dynamic exercising apparatus with the intention of counteracting the occurrence of venous thrombosis (clots in the veins in the legs and in the pelvis) in connection with long-term bed confinements, where bed confinement after having undergone a major operation is one example.

By enabling the flexible spring device or devices to be readily exchanged, the apparatus can be readily adjusted for use in both a dynamic and in an isometric exercising mode. For instance, a patient whose muscles are very weak may begin an exercise period with solely isometric training, and then later proceed to dynamic exercises. Conventional stress-echocardiography with pharmacological agents (e.g. Dobutamin®) must often be interrupted because of adverse side effects, such as headaches, anxiety, agitation, nausea, dyspnoea, arrhythmia and a drop in blood pressure. The inventive apparatus can be used as an isometric or dynamic exercising appliance as an alternative to pharmacological agents in conjunction with stress-echocardiography.

The spring device may include a spring arrangement that is connected to the front side and/or the rear side of the apparatus. When a spring arrangement is provided both on the front side and on the rear side of the apparatus and said spring arrangements are mutually identical, the dynamic load will be distributed essentially equally to the front side and the rear side of the apparatus. When a spring arrangement is connected solely to the front side or to the rear side of the apparatus (or when spring arrangements having mutually different spring characteristics are connected to the front side and the rear side of the apparatus), there is generated a load component that introduces a torque in the symmetry plane of the user, this torque forming a part of the dynamic load to which the user is subjected. Thus, such dynamic load components can be introduced to correspondingly exercise those muscle groups that are influenced hereby, with subsequent loading and exercising of the heart and the circulatory system.

The invention will now be described in more detail with reference to an exemplifying embodiment thereof and also with reference to the accompanying drawings.

Fig. 1 is a schematic illustration of the inventive apparatus from the rear.

5 Fig. 2 is a schematic illustration of the apparatus from the front.

Fig. 3 is a cross-sectional view taken on the line III-III in Fig. 1.

10 The apparatus illustrated in Figs. 1-3 includes a bottom plate 1 that has four attachment points 11-14 (Fig. 3) which define a surface area in whose central part the user's feet 20 can be placed on either side of a line 30 which represents the intersection between the plate 1 and the symmetry plane  
15 of the user 2.

As will be seen from Fig. 1, straps 40, 41 are connected to the attachment points 13 and 14 respectively and also to a fastener element 42 positioned in the symmetry plane 30 of  
20 the user 2. A strap-part 43 extends upwardly from the fastener element 42 to an upper strap fastener 44 in the form of a ring. A harness 50 extends from the fastener ring up over the user's shoulders 22. The harness 50 may comprise two straps 51, 52, each extending over a respective shoulder 22  
25 and being connected to the fastener 44. Load distributing pads 60 may be fitted to the straps 62, such as to be movable along said straps and function to distribute the load from the straps 51, 52 to the upper side of the user's shoulders.

30 It will also be seen from Fig. 1 that the strap-part 43 includes between the attachment devices 42 and 44 a buckle 431 which enables the length of the strap-part 43 between the attachment devices 42, 44 to be adjusted.

35 As will be from Fig. 2, the harness straps 51, 52 are fastened to an attachment device 56 in the symmetry plane 30

on the front side of the user. The attachment device 56 is connected to a lower attachment device 57 by means of a load transmitting device 70 (a strap) connected to a lower attachment device 57, which is also located in the symmetry plane 30. A pair of straps 58, 59 are connected to the attachment device 57 and extend down to the attachment points 12, 11 on the plate 1.

The strap-part 43 is adjusted to a length at which the user is prevented from standing fully upright or lying in completely erected position between the plate 1 and the load distributing pads 60.

The load transferring device 70 includes a load sensing cell 71 which indicates the load exerted by the user between the plate 1 and the load distributing pads 22 when the user straightens his/her body and legs. The load sensor 71 may conveniently also include a display 72 that can be placed in the user's line of view. A clock may also be provided adjacent the display 72.

In preparation for a stress-echocardiography for instance, a doctor may instruct the user to perform a suitable isometric or dynamic muscle exercise with a predetermined load, this load being read on the display 72. The user is then instructed to maintain a given load in the apparatus over a chosen time period. The user sees on the display device 72, either directly or indirectly, that he is exercising at the instructed load, and may also possibly see the time remaining to the end of the exercise period.

As will be seen from Fig. 3, the plate 1 is generally symmetrical in relation to the intersection line between the plate 1 and the plane 30. It will also be seen that the rear edge 16 of the plate 1 has a convex contour which may be comprised of mutually adjacent straight contour-parts each



defining a stable pivot position for the foot plate in a bed when applied to a patient in his/her bed.

5 It will also be seen that the plate 1 may have straight, parallel side-edges 17, 18 that are parallel with the plate symmetry line. A patient lying on his/her side in bed with the inventive apparatus in place will be stabilized by one side-edge of the plate 1 lying stably against the bed surface.

10

The front edge 19 of the plate 1 may be perpendicular to the plate symmetry line or curved in a manner corresponding to the rear edge 16. The skilled person will also realize that the side-edges 17, 18 may also be curved in a manner  
15 corresponding to the rear edge 16.

It will also be understood that the force or power transmission device 70 between the attachment devices 56 and 57 may include a strap-part of adjustable length.  
20 Furthermore, the harness straps 51 and 52 or the straps 40, 41, 58, 59 may, of course, be provided with conventional means for adjusting the length of said straps if so desired.

25 It will also be understood that the straps 58, 59 and 40, 41 may be mutually connected and pass over respective attachment devices 42, 57 in the form of simple rings. The ends of the straps 51 and 52 may also be joined together so as to be able to run through ring-like attachment devices 44, 56.

30 In the case of the illustrated embodiment of the apparatus, which enables dynamic muscle training exercises to be performed, there are connected in the power flow direction of the apparatus spring devices which enable the harness to be extended elastically at a force capable of being exerted by  
35 the user, for instance so that the user is able to stretch to an essentially erect position in the apparatus, with his/her

back and legs straight. Two such spring devices will preferably be connected analogously, one on the front side of the harness, suitably in the strap 70, and one on the rear side of the harness, suitably in the strap 43. In the case of this embodiment, the load sensor 71 and the display 72 belonging thereto are not absolutely necessary.

The spring device 80, 80 may comprise one or more spring arrangements 80 that can preferably be adjusted with respect to their spring characteristics. A spring arrangement may, for instance, be provided in the strap 70 on the front side of the apparatus and/or in the strap 43 on the rear side of said apparatus. In one simple embodiment, the spring arrangement may consist of a rubber-elastic strap which is given different spring characteristics by adjusting the strap to different effective lengths.

Naturally, the spring arrangements 80 may be fitted at other places in the apparatus and may, for instance, be included between the straps 40, 41 and the plate 1 and/or between the straps 58, 59 and the plate 1.

As an alternative to adjusting the spring arrangements 80, said spring arrangements may be replaced with other spring arrangements that have another spring characteristic. The actual apparatus, for instance the plate or the harness, may, of course, be elastically flexible to enable dynamic exercises to be performed on the apparatus.

When the user straightens his/her body in the harness, he/she performs a defined work. The power and work exercised by the user can be determined for different purposes, by repeating this work at a given frequency over a given period of time.

The frequency is controlled with an adjustable metronome/tachymeter and the time can be read from a clock, wherewith

the apparatus may include both a tachymeter and a clock and possibly also calculating devices.

- 5 It will also be understood that the apparatus may include non-stretchable straps or the like that can be connected-up in the apparatus instead of said spring devices or parallel with said spring devices, so as to facilitate conversion of the apparatus between its dynamic and isometric exercising modes. Alternatively, strap-ends that are detachably
- 10 connected to an opposing end of a spring device may be connectable to each other after having disconnected the spring device, so as to form an essentially non-stretchable harness that can be used for isometric exercising.
- 15 Thus, the apparatus illustrated in Figs. 1-3 for dynamic exercising can be readily converted to an apparatus for isometric exercising, by disconnecting the spring device 80 so that the harness/apparatus cannot be stretched but can be adjusted to a size suitable for isometric exercising.

## CLAIMS

1. An isometric/dynamic exercising apparatus comprising a harness (50) which extends over both shoulders (22) of the user (2) and which are anchored to a supportive surface (1) on which the user supports his/her feet, wherein the apparatus includes adjustment means (431) for selectively adjusting the distance between the supportive surface and that part of the harness (50) which acts on the user's shoulders, so that the user can exert an exercising or loading force between the support surface and the harness by straightening his/her body to an upright position, **characterized** in that the apparatus includes a loose, portable bottom plate (1) which forms said support surface, said bottom plate (1) having room for the user's feet in a central plate-part (20); in that the harness (50) includes two first flexible, elongated power transmission elements (51, 52) whose respective ends are fastened to a first and a second attachment device (44, 56) on the rear side and the chest side of the user respectively, essentially in the symmetry plane of the user; in that a first flexible power-transmission device (58, 59) is connected to the plate forwardly of said foot position (20), wherein the first device (58, 59) is connected to a attachment device (57) located in the user's symmetry plane; in that a power-transmission device (70) including a load measuring device (71) is connected between attachment devices (56, 57) located on the front side of the user; in that a second flexible power-transmission device (40, 41) is connected to the bottom plate (1) rearwardly of the user's foot position (20); in that the second power transmission device (40, 41) is connected to a third attachment device (42) which is located in the user's symmetry plane on the rear side of the user; in that a power transmission element (43) is connected between the third attachment device (42) and the first attachment device (44), wherein the power transmission element (43) is

provided with adjusting means (431); and in that the first and the second power transmission devices (58, 59; 40, 41) have together in the bottom plate a total of at least three attachment points (11-14) that define the corner points of a surface area on the plate (1), wherein the plate area intended for the user's feet (20) lies inwardly of the edge of the polygonal area defined by said corner points.

2. An apparatus according to Claim 1, **characterized** in that the plate (1) has a generally convex rear edge (16).

3. An apparatus according to Claim 1 or 2, **characterized** in that the plate (1) has side edges (17, 18) that are generally straight and parallel with an intersection line between the user's symmetry plane and the plate (1).

4. An apparatus according to Claim 2 or 3, **characterized** in that the convex rear edge of the plate (1) has a polygonal shape and is composed of generally straight edge-parts.

5. An apparatus according to any one of Claims 1-4, **characterized** in that the first device (58, 59) includes two power-transmitting elements (58, 59) that are connected to the plate (1) at two laterally separated attachment points on each side of an intersecting line between the plate (1) and the user's symmetry plane (30); and in that the second device (40, 41) includes two power-transmitting elements that are connected to the plate (1) at two laterally separated attachment points on respective sides of an intersection line between the plate (1) and the user's symmetry plane (30).

6. An apparatus according to any one of Claims 1-5, **characterized** by a measuring device (71) connected in the apparatus for measuring the tensile force exerted by the user when stretching his/her body, said measuring device

preferably supporting a display (72) that can be positioned so as to enable the user of the apparatus to see the display.

5 7. An apparatus according to any one of Claims 1-6, **characterized** in that the apparatus is essentially non-stretchable and is functional for isometric training or loading exercises, wherein the adjustment device can be adjusted to permit the back and leg muscles to be stretched to a maximum load, and wherein the harness prevents the user  
10 from standing or lying in an erect position in the apparatus with his/her legs straightened.

8. An apparatus according to any one of Claims 1-6, **characterized** by a flexible spring device (80, 80) which  
15 enables the user to straighten his/her body in the apparatus against the force exerted by said spring device, wherewith the apparatus enables dynamic muscle exercises to be performed by the user.

20 9. An apparatus according to any one of Claims 1-8, **characterized** in that the spring device (80, 80) includes a spring means which is included in the apparatus harness on its front side and/or on its rear side.

25 10. An apparatus according to one of Claims 8 or 9, **characterized** in that at least one spring means (80) in the apparatus can be adjusted to establish a selective spring characteristic.

Fig. 1

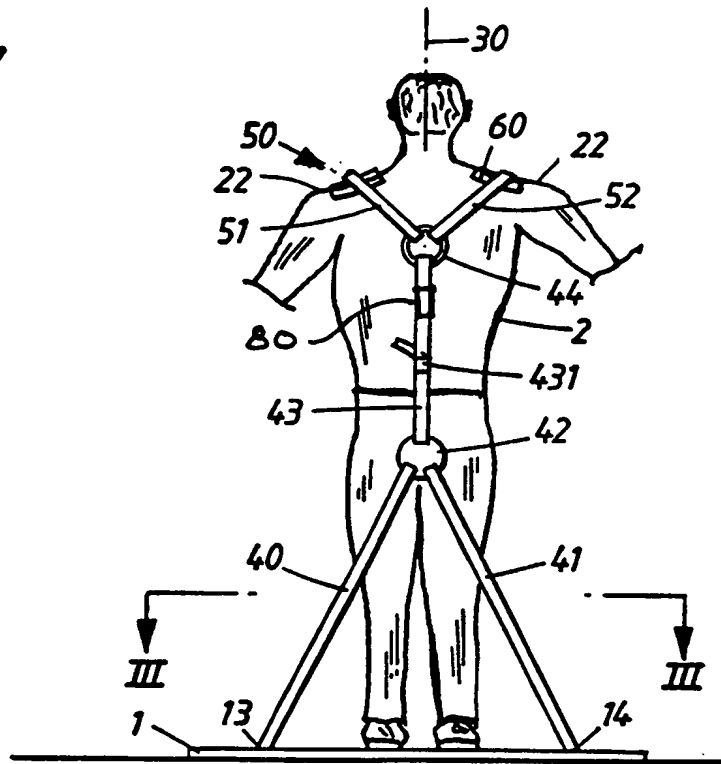


Fig. 2

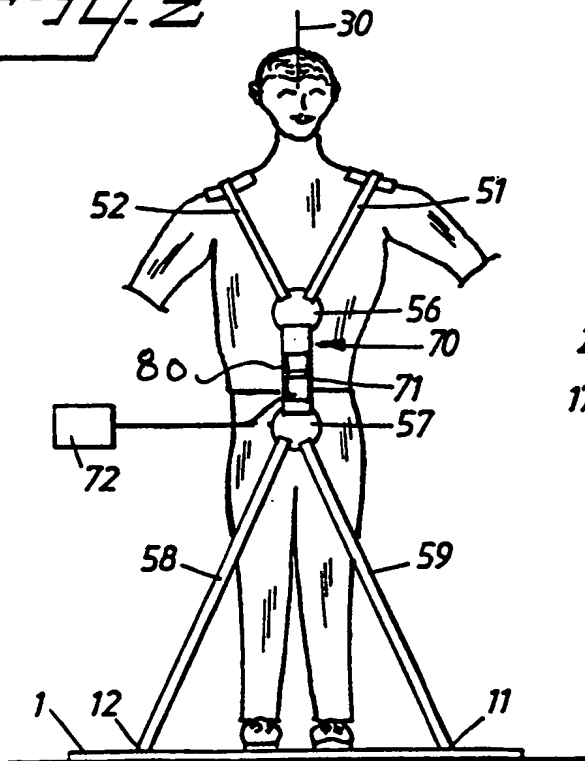
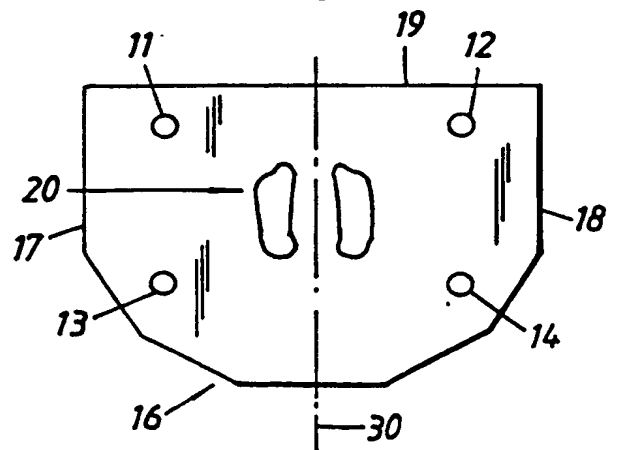


Fig. 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/01948

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: A63B 23/04, A63B 23/02

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 882181 A (J.P. THOMAS), 17 March 1908 (17.03.08), page 1, line 74 - line 89; page 2 --	1,3-6
A	US 4371162 A (R.P. HARTZELL), 1 February 1983 (01.02.83), column 2, line 36 - line 52, figures 1, 2 --	1,3-5,9,10
A	US 2097376 A (J.H. MARSHMAN), 26 October 1937 (26.10.37), page 1, column 1, line 39 - line 41; column 1, line 55 - column 2, line 19, figure 1 --	1,5

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

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PCT/SE 97/01948

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 1663641 A (G.S. SMALLWOOD), 27 March 1928 (27.03.28), page 1, line 36 - line 76; page 1, line 97 - line 111, figure 2  --	5
A	SE 459902 B (T. AHRLING), 21 August 1989 (21.08.89), page 2, line 26 - line 29; page 3, line 8 - line 15, figure 6  --	1,4,5
A	DE 4430042 A1 (FÖRDERVEREIN INSTITUT FÜR MEDIZINTECHNIK DRESDEN EV), 9 March 1995 (09.03.95), column 2, line 40 - column 3, line 9, figure 1  --	1
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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

03/02/98

International application No.  
PCT/SE 97/01948

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
US	882181	A	17/03/08	NONE	
US	4371162	A	01/02/83	NONE	
US	2097376	A	26/10/37	NONE	
US	1663641	A	27/03/28	NONE	
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